## Estimation of fetal age by means of ultrasound

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Probably, the most frequent question to an ultrasonic department, servicing not only the clinic, but as well the gynecological practitioners, is that for the gestational age. The exact knowledge of the gestational age is not only of importance in cases of risk pregnancies but as well in cases of uncertain and irregular menstrual period. Approximately 15 - 2o % of the women today are unable to give exact information about the menstrual history. This is due not only for hormonal reasons but as well for amenorrhoea after hormonal contraception and amenorrhoea following the insertion of an IUD.

For the estimation of the gestational age by means of ultrasound different methods, depending on the time of gestation are available.

In early pregnancies a correlation between different uterine measurements as the longitudinal, a.p. and transverse diameters was tried. The deviation was however too big to be of any clinical importance.

A much better correlation exists between the different diameters of the gestational sac and the length of amenorrhoea.

The gestational sac becomes visible inside the uterus from the 5 - 6 week of amenorrhoea onwards. Using the clear echo of the inner contur the longitudinal, the a.p. and transverse diameter can be measured.

Figures published by different authors show a good agreement with the 6 - 7th week. In more advanced stages of pregnancy because of the biologic variability the deviation becomes greater. In these echograms more complicated and time-consuming measurements as the circumference, the area by planimetry can be calculated. It was demonstrated however that the accuracy does not increase with the more elaborate measurements.

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The best correlation in this respect is demonstrated by the average diameter of the gestational sac.
Already Robinson criticised the estimation of gestational age using sac-diameters, because of the deformation of the gestational sac induced by the stage of filling of the neighbouring organs as bladder and intestine. For these reasons he recommended the calculation of the sac-volumen. This volume increases from 1 ml in the 6th week to 1oo ml in the 13th week. By means of the volume gestational age may be calculated correctly with a deviation of $\pm$ 9 days. The method however is too time-consuming for clinical routine and should be substituted by the sac-diameter.
The most reliable method for estimating gestational age is the measurement of the crown-rump length published by Robinson. This method can be used from the 7th - 14th week of gestation. Within this time the fetus is crowing from 1o - 83 mm which corresponds to a daily growth of 1,4 mm in this time.
Because of this rapid and linear growth even minor methodical errors in performing the measurement foes not influence the estimation severely. By this method the gestation time can be calculated with a deviation of only $\pm$ 4,7 days. Because of the movements of the fetus in this early period the measurement could not be performed in approximately 1/3 of the pregnancies using compound scanners. Today with real-time machines the measurement is easely accessable in short time.
Another relatively simple measurement which gives nearly the same good results measuring the crown-rump length was published by Schillinger. He uses for the estimation of the gestational age in early pregnancy the diameter of the fetal thorax. Performing a longitudinal scan outlining the gestational sac' the round shaped fetal thorax can be demonstrated within the sac. The ultrasonic beam is directed against the fetal thorax for recording the fetal heart-beat. In the time-motion

picture the fetal heart structures are bordered by the echo of the fetal thorax. The distance of thes lines taking from middle to middle gives a good correlation to the gestational age. The deviation is only 5,7 days compared with 4,7 days of measuring the crown-rump length.
It was mentioned before that the measurement of the gestational sac and the other parameters is influenced by the filling of the bladder and intestine. Another reason which may influence these measurements are slow uterine contractions which can be observed during these early stages of pregnancy. As the duration of this contraction can be up to 1o minutes, it can be observed as well with compound scanning. This slow contraction may seize different uterine parts one after the other. In quick and short examinations these contractions may lead errenouous interpretations of the echogram. In early pregnancy the contraction may simulate a twin pregnancy with only one single vital fetus. The contraction might be misinterpreted as fibroids.
When these contractions are at the site of the placenta, the placenta may be shifted in such a way that a placenta praevia may be diagnosed.
These uterine changes might be correlated to Braxton-Hicks contractions. It seems that they can be registered more often in very sensitive and anxious patients. This can be frequently observed during amniocentesis in early pregnancy. This local contraction may be as well the reason for failures in puncturing the amnio-cavity as a primarely placental free site.

In the second and third trimester the gestational age can be calculated from head and abdominal measurements. As paramters the head and abdominal diameters perpendicular to each other, the circumferences and the areas can be used.
The best correlation to the gestational age is given by the biparietal diameter as read in A-scan. It must be stressed that because of the biologic variation the measurement should be performed until the 25th week. The deviation of $\pm$ 7 days is clinically acceptable.

Using the average abdominal diameter additional to the biparietal diameter the accuracy can be improved. From the 34th week of gestation the abdominal diameters are better than the head measurements in estimating the gestational age. The table gives the deviation in days for the different parameters in estimating fetal age.

In the connection with biometry ultrasonic pelvimetry should be briefle mentioned as well. Performing longitudinal scans in the midline the maternal spine and the promontory can be sufficiently outlined to perform pelvimetry.
The dorsal surface of the symphysis can be demonstrated more easily by using the full bladder technique. This acoustic window makes it possible as well to demonstrate the portio in front of the fetal head. Cranially the posterior uterine wall is demonstrated which might be misinterpreted as flat sacrum. Using low frequencies and sufficient gain the posterior skinsurface of the patient can be outlined.
It must be emphasized tha this measurement can be performed only with compound scanners and not with real-time machines.
It should be demonstrated that the pubic arch and the pelvic outlet can be outlined by means of ultrasound.
Ultrasound pelvimetry was performed in all cases of breech presentation, questionnable cephalo-pelvic-disproportion and in all cases with a conjugata externa of less than 19 cm.
It was possible to forecast a disproportion if the difference between the biparietal diameter and the conjugate was 1 cm or less.
Performing ultrasonic pelvimetry we were able to reduce X-ray pelvimetry for borderline cases.

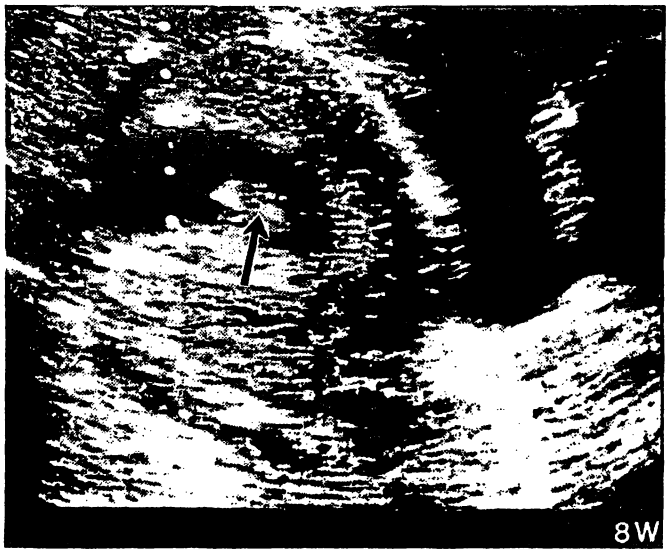


Fig. 1 Measurement of the vertex-breech length

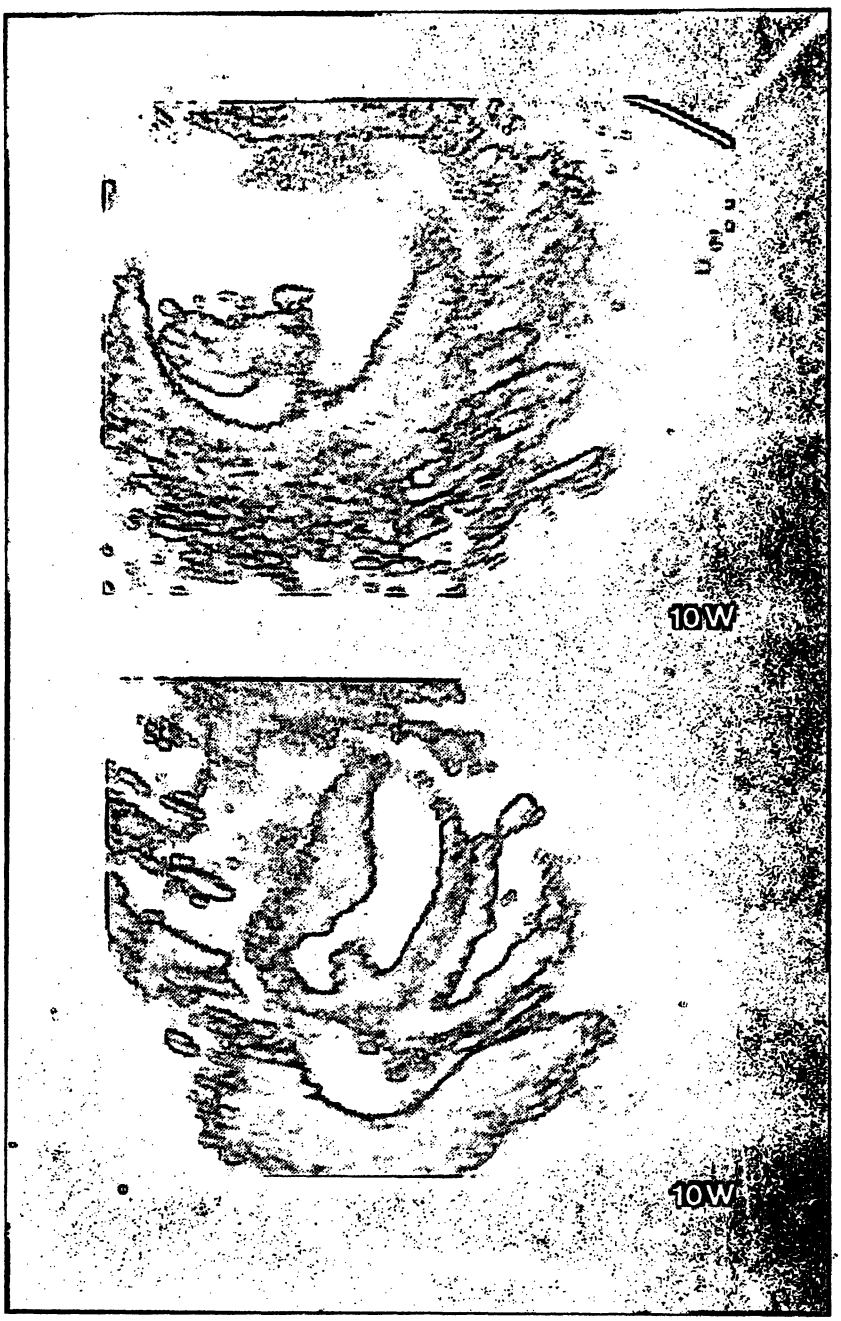


Fig. 2 Measurement of the gestational sac diamter and volume
Below: Measurement of thorac diameter

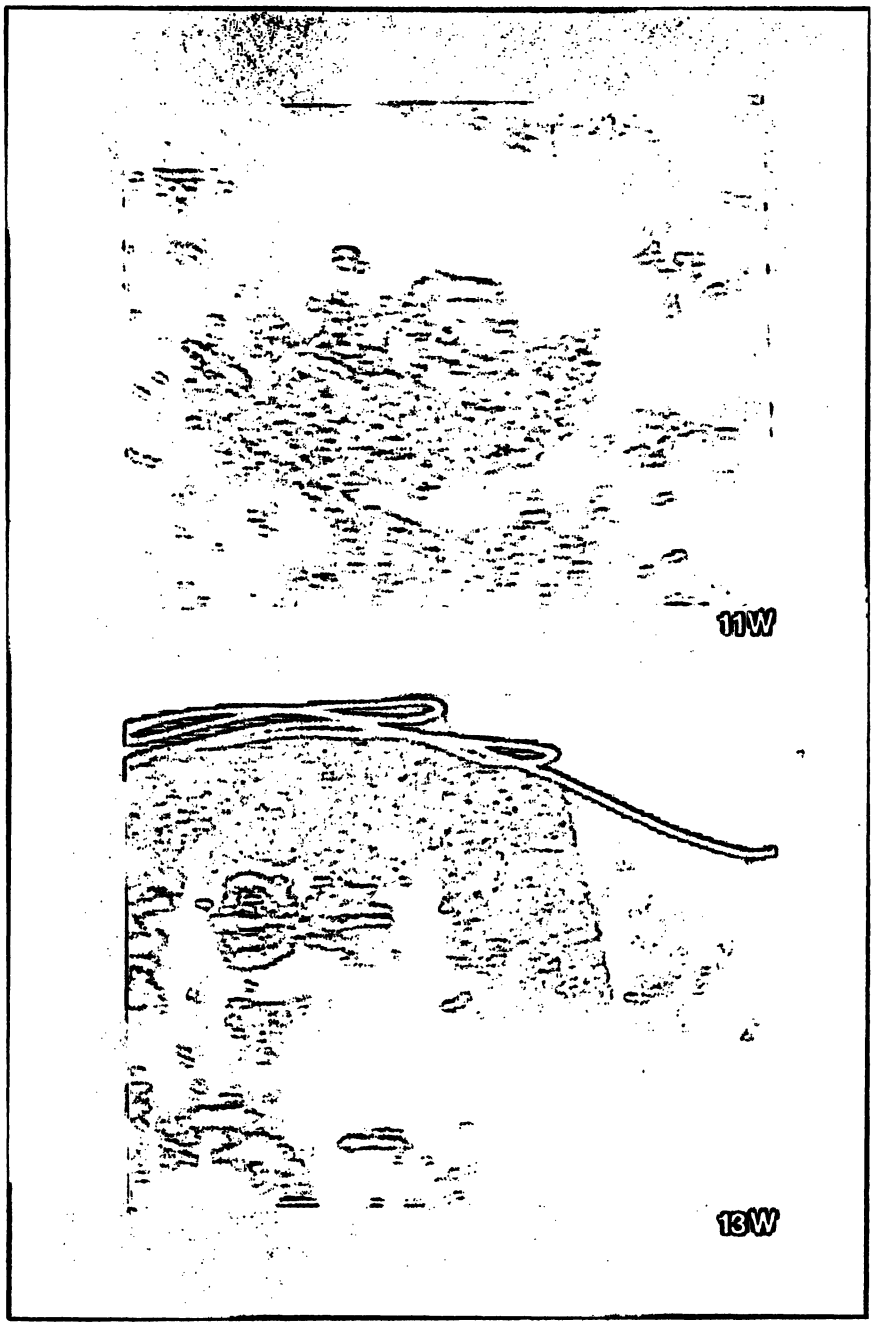


Fig. 3 Measurement of the biparietal diameter in very early pregnancy
in very early pregnancy

Fig. 4
Uterine contractions
at the posterior uterine
wall


Fig. 5 Measurement of the true conjugate:
H = Head, Sy = Symphysis, P = Promontory,
IVD = Intervertebral disc, Pl = Placenta, Tr = trunk

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